Journal of Research in Forestry, Wildlife & Environment Vol. 14(1) March, 2022
***E-mail:** jrfwe2019@gmail.com**;** jfewr@yahoo.com*
http://www.ajol.info/index.php/jrfwe

jfewr ©2022 - jfewr Publications
ISBN: 2141 – 1778
Odeyemi et al., 2022

INVENTORY OF PARASITIC PLANTS (MISTLETOES) HOST RANGE IN FOREST AND PLANTATION COMMUNITY OF HUMID FOREST RESEARCH STATION UMUAHIA, NIGERIA

Odeyemi S.A., Koyejo A.O., Ejizu A.N. and Nwachukwu, J. Q.

Forestry Research Institute of Nigeria, Humid Forest Research Station, Umuahia, Abia State, Nigeria.
***Corresponding Author**: *toyes618@gmail.com*; +234 806 832 1432

ABSTRACT

The host range assessment was investigated in Humid Forest Research Station Umuahia between the year 2019 and 2020 with the view of documenting the host range species in the station premises. The visual method of counting was adopted in this study. Both angiosperm and gymnosperm tree species were examined. Out of 21 families that were investigated, 14 families were infected with parasitic plants. The remaining 7 families were found not being harbored mistletoes. These were Moraceae, Sapotaceae, Ebenaceae, Clusiaceae, Steculiaceae, Bombacaceae and Cupressaceae. At generic levels, 20 genera belonging to 25 tree species were infected with parasitic plants. The total number of individual trees harboring mistletoes were 84, out of which Tectona grandis took 28.56 %. The identified mistletoes species during the study were Agelanthus pungu, Phragmenthera incana and Phragmenthra capitata. They were parasitized 29.2%, 12.5% and 58.3% of infected tree species respectively. The study actually highlighted the host range species among gymnosperm and angiosperm tree species in the forest and plantation community of the study locality.

Key words: Mistletoes, angiosperm, gymnosperm, host range.

Correct Citation of this Publication

Odeyemi S.A., Koyejo A.O., Ejizu A.N. and Nwachukwu, J. Q. (2022). Inventory of Parasitic Plants (Mistletoes) Host Range in Forest and Plantation Community of Humid Forest Research Station Umuahia, Nigeria. *Journal of Research in Forestry, Wildlife & Environment*, 14(1): 43 - 52

INTRODUCTION

The effect of biotic factors on plant expression may be advantageous or disadvantageous, depending on how they interact with the plant. These interactions include mutualism, herbivory, parasitism and allelopathy. The typical plant is an autotrophic organism that obtains its necessary resources: sunlight, water and minerals from the abiotic environment (Clarke, 1993). The perspective, however, overlooks the large number of plants that consume other plants, obtaining much or all of their nutrition from their prey (Steven and Ragan, 2002). Parasitism is an interaction between two organisms in which one organism called parasite is benefited but causes harm to another, called host. Examples of parasitic plants are the dodder, mistletoes and some orchids (Postlethwait and Hopson, 1989). Biotic disturbance is affecting a wide range of tree species in all climates and their occurrence is contributing to increasing rate of tree mortality globally (Anne *et al*., 2007). Mistletoes are a widespread group of plants whose negative effects on tree growth and mortality-often by increasing the sensitivity of their host to stress-are well established. Mistletoes affects the productivity of several non-timber forest product, most significantly Amla (*Phyllathus emblica* and *Phyllathus indofischeri*), whose fruits provide an important source of income for indigenous forest communities (Lucy *et al*., 2011). *Arceuthobium spp* causes an eventual decrease in growth and vigor in any individual tree on which it is found (Robert *et al*., 1982). They are highly specialized

perennial flowering plants adapted to parasitic life on aerial parts of their hosts. Their infections may disrupt the host stomata control system, causing early and oscillating closure of stomata, thereby diminishing host photosynthetic gain (Glatzel and Geils, 2008). With climate change, parasitic plants are spreading further north in Europe and further south in Africa (Rubiale and Heide-Jorgensen, 2011). Mistletoe (*Loranthus micranthus*) reported to be medicinally multi-potential (Osadebe and Ukwueze, 2004). Like herbivores, parasitic plants can have strong impacts on the communities in which they occur, altering plant community biomass, species composition, diversity and dynamics (Pennings and Callaway, 2002). The acquisition of host resources can exert strong effect on host growth, allometry, reproduction and physiology (Press *et al*., 1999). Community-level impacts of parasitic plants depend on mainly on which species are parasitized (Malcolm and Gareth, 2005). Host range varies from one acceptable host (e.g. the dwarf mistletoe *Arecuthobium minutissimum* on *Pinus griffithii*) to several hundred for certain members of Loranthaceae, Viscaceae and Orobancaceae (Kuijt, 1969). Most parasitic plants can potentially attack a large number of different co-occurring species, (that is, they have a broad host range), often simultaneously (Pennings and Callaway, 2002; Westbury, 2004). Many fundamental aspects of the ecology of parasitic plant remain poorly studied and research to date has been dominated by laboratory studies rather than by studies of natural communities. Parasitic plants have broad host ranges, and allocation patterns that can be strongly affected by host identity (Pennings and Callaway, 2002). Host range is the number of host species used by a parasite, it can also be regarded as the number of hosts that a parasite can use as a partner (Poulin and Randhawa, 2015). Parasitic plants were reported to be discriminating in host selection (Rubiale and Heide-Jorgensen, 2011). This study therefore aimed at examining the different potential host species that are present at the premises of Humid Forest Research Station, Umuahia, Nigeria.

MATERIALS AND METHODS

Study Area

The Forestry Research Institute of Nigeria, Humid Research Station located at periphery of Umuahia town Nigeria. The forest station lies on latitude 5^0 30˙48¨N to 5^0 32`15¨ N and longitude 7^0 31˙03¨E to $7^0$31˙32¨E along Umuahia/Ikot-Ekpene road, Umuahia, at an altitude of over 122 m above sea level (Okeke *et al*., 1995) (Fig.1).The vegetation is a typical of lowland rain forest of south eastern Nigeria with a total area of approximately 32 hectares. The rainfall pattern is bimodal with peaks around June to July and September to October, annual rainfall is 2238 mm; the mean minimum and maximum temperature are 23 ^{0}C and 30 ^{0}C respectively, while relative humidity is 86.4% (Ariwaodo and Harry-Asobara, 2015). The vegetation has been described as high forest and soil type is sandy loam trees are grown both in plantation and isolation pattern. Exotic and indigenous trees are the species made up of the tree community of the area (Okeke *et al.*,1995).

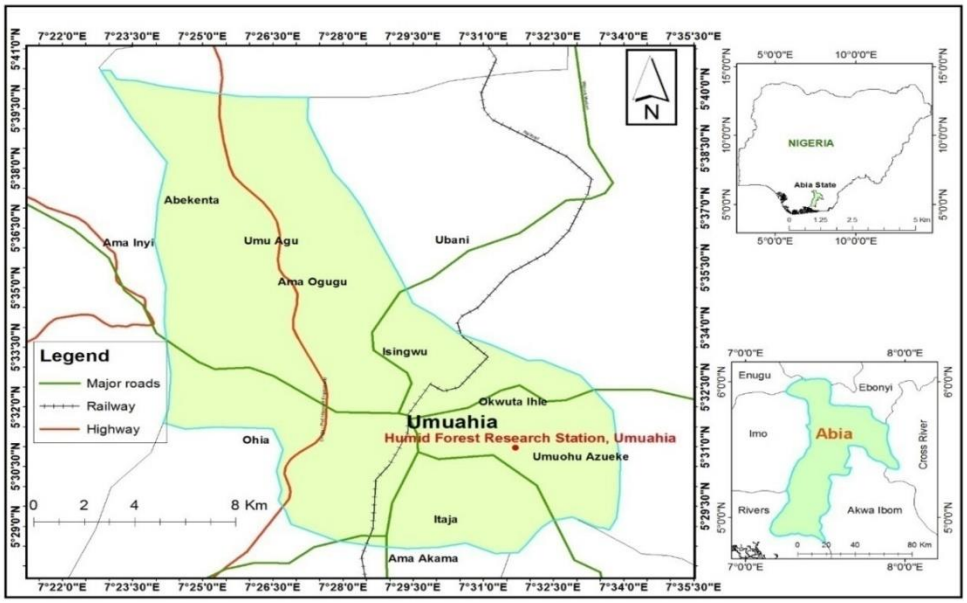

Figure 1: Map showing the description of the study area

Experimental design

The assessment of tree species infected by plant parasites (mistletoes) was carried out between the year 2019 and 2020. The assessment was focused on timber and fruit trees species within the forest station. The trees assessed grown in mini plantations, orchard and in isolation. Thorough visual examination of those trees, that is, manual inventory was used to assess the host range (Carnegies *et al.*, 2009; Turner and Smith, 2016).

Data collection

The assessment was done during two major phenological events (leafing and defoliation period) of the tree species. In the study area, 560 m baseline, 10 m away from the main access route, was laid in the study area. Seven (7) transect of 80 m were made in the study forest community. Along each transect two 50x50 m (0.25 hectare) were randomly selected for the identification of mistletoes host range. A total of 3.5 hectare was used for the survey. The number of infected trees by mistletoes were recorded. The dead infected tree species were also assessed and recorded. The species of plant parasite which infected each tree were collected and sent to the herbarium at Forestry Research Institute of Nigeria, in Ibadan for proper identification.

RESULTS

Table 1 depicted the families and the species under the study. In the angiosperm group, 19 families were assessed and recorded with 37 genera and 48 tree species. While in the gymnosperm group 2 families with 2 genera and 3 tree species were assessed and recorded for parasite host range (Table1).

Table 2 shows the tree species infected with mistletoes in the study area. Out of 21 families that were assessed and recorded for the mistletoes host range, 7 families with their assessed members were found not being infected by parasitic plants (mistletoes).while 14 families with 25 species were infected out of 36 species assessed in them (Table2 and Figure2) The family which were not harbored mistletoes include Moraceae, Sapotaceae, Ebenaceae, Clusiaceae, Steculiaceae, Bombacaceae and Cupressaceae. The total number of genera that were infected was 20 while 18 genera were found not being infected.

Table 1: Tree species assessed for mistletoes host study

S/No.	Family	Species
	Angiosperm	
1	Verbenaceae	*Gmelina arborea*
		Tectona grandis
2	Meliaceae	*Cedrela odorata*
		Entandrophragma cylindricum
		Lovoa trichiloides
		Khaya senegalensis
		Khaya grandifoliola
3	Irvingiaceae	*Irvingia gabonensis*
		Irvingia wombulu
4	Combretaceae	*Terminalia superb*
		Terminalia ivorensis
		Terminalia mantaly
		Terminalia catappa
5	Buseraceae	*Canarium schweinfunthii*
		Dacryodes edulis
6	Fabacaea	*Penthaclethra macrophylla*
		Dentarium macrocarpum
		Acacia auriculiformis
		Pericopsis elata
7	Myrtaceae	*Psidum guajava*
		Eucalyptus camadulensis
		Eucalyptus toriliana
8	Rutaceae	*Citrus paradise*
		Citrus sinensis
		Citrus reticulate
9	Moraceae	*Milicia excels*
		Treculia africana
10	Sapotaceae	*Chrysophyllum albidum*
		Chrysophyllum delevoyi
		Baillonella toxisperma
11	Annonaceae	*Monodora myristica*
		Xylopia aethiopica
12	Ebenaceae	*Diospyros crassiflora*
13	Ceasalpinaceae	*Afzelia Africana*
		Senna fistula
		Senna siama
14	Luretaceae	*Persea Americana*
15	Clusiaceae/Guttiferea	*Allanblackia floribunda*
		Pentadesma butyraceae
		Garcinia kola
		Garcinia manii
16	Boraginaceae	*Cordia alledora*
17	Sterculiaceae	*Triplochyton scleroxylon*
		Cola pachycarpa
18	Anacardiaceae	*Mangifera indica*
		Anarcardium occidentale
		Spondia mombin
19	Bombacaceae	*Ceiba pentandra*
	Gymnosperms	
20	Pinaceae	*Pinus oocarpa*
		Pinus caribaea
21	Cupressaceae	*Callitris egyptica*

Table 2: Tree species infected with mistletoes in the study area

S/No	Family	Tree species	Mistletoes species
1	verbenacea	*Gmelina arborea*	*Phrangmenthera capitata*
		Tectona grandis	*Phragmenthera capitata and P. incana*
2	Meliaceae	*Cedrella odorata*	*Phragmenthera capitata*
		Entandrophragma cylindericum	*Agelanthus pungu*
		Lovoa trichiloides	*Phragmenthera capitata*
		Khaya senegalensis	*Agelanthus pungu*
3	Irvingiaceae	*Irvingia gabonensis*	*Agelanthus pungu*
4	Combretaceae	*Terminalia superb*	*Agelanthus pungu*
		Terminalia ivorensis	*Phragmenthera capitata*
		Terminalia mantaly	*Phragmenthera capitata*
		Terminalia catappa	*Phragmenthera capitata*
5	Buseraceae	*Dacryodes edulis*	*Phragmenthera capitata*
		Canarium schweinfunthii	*Phragmemthera capitata*
6	Fabaceae	*Penthaclethra marophylla*	*Phragmenthera capitata*
		Acacia auriculoformis	*Agelanthus pungu*
7	Boraginaceae	*Cordia alledora*	*Agelanthus pungu*
8	Myrtaceae	*Psidum guajava*	*Phragmenthera capitata*
9	Rutaceae	*Citrus paradisi*	*Phragmenthera capitata*
		Citrus sinensis	*Phragmenthera capitata*
		Citrus reticulata	*Phragmenthera capitata & P. incana*
10	Ceasalpinaceae	*Senna siama*	*Phragmenthera capitata*
11	Lureceae	*Persea americana*	*Phragmenthera capitata and P. incana*
12	Anarcardiaceae	*Spondias mombin*	*Phragmenthera capitata*
13	Annonaceae	*Monodora myristica*	*Agelanthus pungu*
14	Pinaceae	*Pinus caribea*	*Agelanthus pungu*

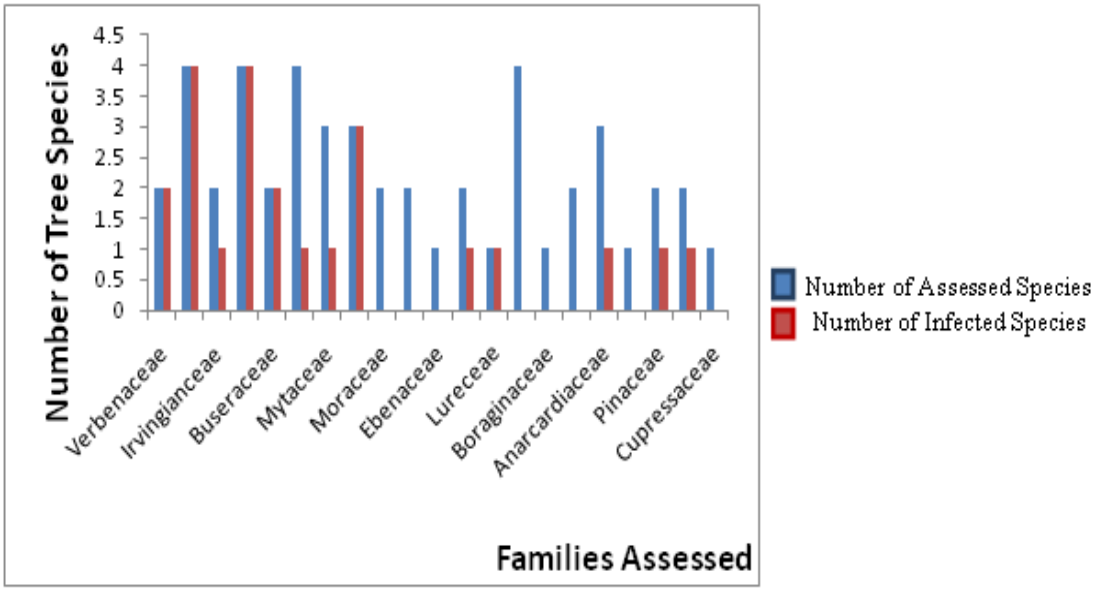

Figure 2: Showing the number of assessed and infected species in each family.

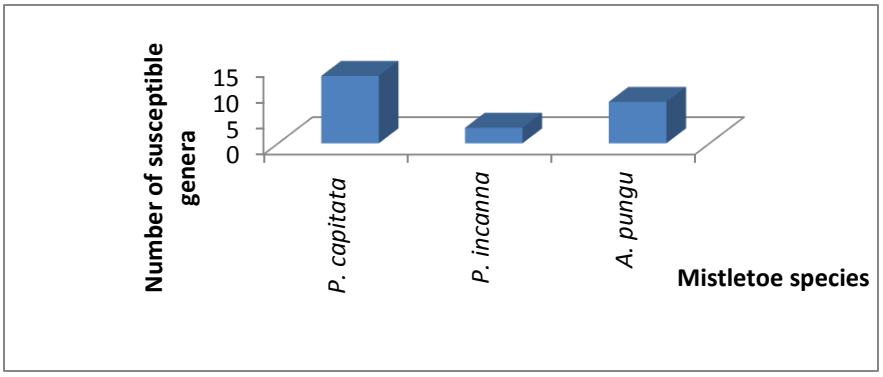

Figure 3: showing the number of genera infected by the mistletoe's species

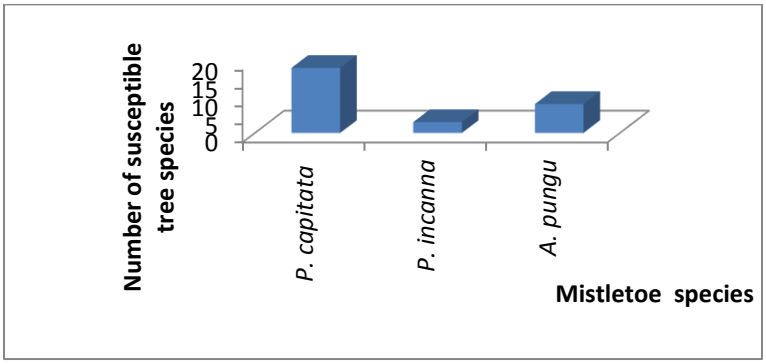

Figure 4: Showing the number of species infected by the mistletoe's species

Table 3 depicts the tree species that were not parasitized by any of the mistletoe's species found in the study community. Both angiosperm and gymnosperm group were found in this category. In angiosperm group, 24 tree species were found not being parasitized while only 2 tree species were also found not being parasitized among gymnosperm group.

Table 3: Uninfected tree species in the study community

S/No.	Species
	Angiosperm group
1	*Khaya grandifoliola*
2	*Irvingia wombulu*
3	*Dentarium macrocarpum*
4	*Pericopsis elata*
5	*Eucalyptus camadulensis*
6	*Eucalyptus toriliana*
7	*Melicia excels*
8	*Treculia Africana*
9	*Chrysophyllum albidum*
10	*Chrysophllum delevoyi*
11	*Ballonella toxiperma*
12	*Xylopia aethopica*
13	*Diospyros crassiflora*
14	*Afzelia Africana*
15	*Senna fistula*
16	*Allanblankia floribunda*
17	*Pentadesma butyracea*
18	*Garcinia kola*
19	*Garcinia manii*
20	*Triplochyton scleroxylon*
21	*Cola pachcarpa*
22	*Manigifera indica*
23	*Anarcardium occidentale*
24	*Ceiba pentandra*
	Gymnosperm group
25	*Pinus oocarpa*
26	*Callitris egyptica*

In table 4, a total number of 83 individual trees were found being harbored parasitic plants in the study tree community with 32 trees harboring parasitic plants in *Tectona grandis* stand. Four dead trees of *T. grandis* were recorded with massive dead mistletoes on them. There was no mortality in other infected tree species assessed in the study area.

Table 4: The number of infected individuals in each tree species

S/No.	Tree species	Number of infected individuals
1	*Gmelina arborea*	3
2	*Tectona grandis*	32
3	*Cedrella odorata*	4
4	*Entandrophragma cylindricum*	2
5	*Lovoa trichiloides*	4
6	*Khaya senegalensis*	2
7	*Irvingia gabonensis*	2
8	*Terminalia superb*	4
9	*Terminalia ivorensis*	2
10	*Terminalia mantaly*	1
11	*Terminalia catappa*	1
12	*Persae Americana*	3
13	*Dacryodes edulis*	1
14	*Canarium schweinfunthii*	1
15	*Penthaclethra macrophylla*	2
16	*Psidum guajava*	6
17	*Citrus paradise*	1
18	*Citrus sinensis*	4
19	*Citrus reticulate*	2
20	*Senna siama*	2
21	*Acacia auriculoformis*	1
22	*Monodora myristica*	1
23	*Cordia alledora*	1
24	*Spondias mombin*	1
25	*Pinus caribaea*	2
	Total	**83**

In table 5, based on the identification of mistletoes species which was carried out in Forestry Research Institute of Nigeria herbarium in Ibadan we came up with 3 species of mistletoes on the assessed tree species (Table5 and Fig.5). Out of 25 infected trees species, 17 tree species (58.3 %) were infected by *Phragmenthera capitata*, 8 tree species (29.2 %) were infected by *Agelanthus pungu* and only 3 tree species (12.5 %) were infected by *P. incana*. The tree species that were infected with both *P. incana* and *P. capitata* include *Tectona grandis*, *Persea americana* and *Citrus reticulata*. The mistletoes species were found growing on twigs and branches of the host species. But in *Entandrophragma cylindricum*, the mistletoes were found growing on the petiole of the leaf.

Table 5: The identified mistletoes species in the study community with herbarium reference number

S/No.	Species	FHI Number
1	*Agelanthus pungu* (De wild.) Polh and Wiens	0098695
2	*Phragmenthera incana* (Schum) Balle	0034616
3	*Phragmenthera capitata* Balle	92337

Phragmenthera capitata

Agelanthus pungu

Phragmenthera incana

Figure 5: Showing the picture of identified mistletoes species in the study area.

DISCUSSION

Host specificity has been investigated for centuries in mistletoes, viruses, insects, parasitoids, lice and fluke, yet it is poorly understood (Desale *et al.,* 2016). Community-level impacts of parasitic plants depend on mainly on which species are parasitized (Malcolm and Gareth, 2005). The two groups of plant species (angiosperm and gymnosperm) that were assessed for the mistletoes host range were found harboring mistletoes. This is an indication that parasitic plant foraging on both flowering and non-flowering plants (Nickren and Musselman, 2004). From table 1, out of the 49 tree species assessed for parasite host range in the locality, only 25 tree species (51.02%) were parasitized with 93.9% in angiosperm group and 6.1% in gymnosperm group. The uninfected tree species were 25 (48.9%) of the assessed tree species with 46.9% in angiosperm group and 4.1% in gymnosperm group.

The 25 tree species that were infected by mistletoes offered the environment that allows the germination of seeds from mistletoes while the 24 tree species that were not harbored mistletoes offered the environment which was not favourable for the germination of seed from mistletoes. Because the environmental conditions offered by the host trees represent the immediate environment that the seed propagule must face and differences in host resources quality (Watson 2009), growth rate (Hautier *et al*., 2010), and resistance to parasitism (Seel 2007, Hautier *et al.,* 2010), affect parasite performance. Within the context of environmental heterogenesity, this variation has consequences for hemi-parasites at the level of the individual and population (Watson 2009). The selection of host occurred on the trees growing both in plantation and in isolation. This is an indication that parasitic plants can be found on tree grown in plantation and isolation and in natural and semi-natural ecosystem (Press, 1998). At the family level (Table3 and Figure 2), 14 families were infected with mistletoes. The compatibility which occurred between some members of infected families and parasitic plants indicates that there are common traits among those families which allow the mistletoes to forage and grow on them (Press and Graves, 1995; Downey 1998). Although diverse factors influence mistletoes-host compatibility but host traits influence the establishment and survival of mistletoes and these traits further affect the distribution of mistletoes among host trees (Desale *et al.,* 2016). Parasitic plants are very diverse and display a considerable variation in host-specificity (Norton and Carpenter 1998; Norton and de Lange 1999; Thorgood and Hiscock, 2010).

The 3 species of mistletoes identified in this study- *Phragmenthera capitata*, *P. incana and Agelathus pungu* (Table 5 and Figure 5) have the adaptive feature (host-specific adaptation) that make them grow and survive in the locality. At

the locality (study area) *Phragmenthera capitata* can be regarded as generalist parasite because it parasitizes 67% of host range. *P. incana* can be regarded as specialist because it utilizes few host species (9 % of infected host) in the locality. The *Agelanthus pungu* can also be regarded as specialist because it utilizes 24 % of host range at the locality. Many parasitic plants can simultaneously parasitize multiple host individuals (Gibson and Watkinson 1989, Kelly and Horning 1999). In this host range assessment, the same mode of host use was observed in which *Phragmenthera capitata* and *P. incana* utilize *Tectona grandis*, *Citrus spp*. and *Persea americana* simultaneously. Parasites may behave as discriminate consumers by increasing their parasitism of better host (that is, the host that most greatly enhances the growth, reproduction and fitness of the parasite population). The population of *T. grandis* was observed to be the most potential host for the shoot parasitic plants in the study locality. What makes *T. grandis* better than others is not clear, although studies to date show that both root and shoot parasites often prefer or perform better on hosts with a high nitrogen content, such as legumes (Schulze and Ehlering 1984; Kelly, 1992; Seel and Press, 1999), or host that have readily accessible vascular systems (Kelly *et al*.,1999) and/ or lower defense capacity (Cameron, 2004; Cameron *et al*., 2005).

The 4 dead individual that were recorded in *T. grandis* population may be as a result of massive mistletoes that depend on them for their survival and those hosts cannot adapt to control the negative impact of parasite on them (Poulin and Randhawa, 2015). Nickren and Musselman (2004), reported that at least 30 genera of mistletoes in the Loranthaceae occur on introduced or cultivated trees and the following have been reported to be particularly damging; *Tapinanthus bangwensis* on cocoa (*Theobroma cacao*) in Africa, *Dendrophthoe pentandra* on Kapok (*Ceiba pentandra*) in Jova, *Passovia pyrifolia* on teak (*Tectona grandis*) in Trinidad, and *Oryctanthus occidentalis* on cocoa in Costa Rica. Host range varies widely among species of parasitic plants. In this study *P. capitata* parasitized 17 host species in different 9 families, *P. incana* parasitized 3 host species in different 3 families and *A. pungu* parasitized 7 host species in different 6 families. This is in line with the report of Muselman and Press (1995), that single species of *Cuscuta* and *Castilleja* can parasitize hundreds of host species in many different families. Whereas some species of mistletoe parasitize only one host species. Those species that were not parasitized during the study may still be an acceptable host. The reason for the absence may be ecological such as the lack of a suitable dispersal agent (e.g birds), or the light condition may be insufficient for the parasite (Rubiales and Heide-J0rgensen, 2011).

CONCLUSION

This study has highlighted the host range in the study area. The gymnosperm and angiosperm were host range to parasitic plants. Our study revealed that the members of Moraceae, Sapotaceae, Ebenaceae, Clusiaceae, Steculiaceae, Bombacaceae and Cupressaceae families were not harbored mistletoes. *T. grandis* was the most susceptible tree species and it was foraged by two different species of mistletoes (*P. capitata* and *P. incana*). If there is a need to work further on parasitic plants and host range, both gymnosperm and angiosperm tree species should be the focus and extensive research work should be carried out on *T. grandis* and mistletoes relationship in order to add to the ecology of parasitic plants.

REFERENCES

Cameron D.D, Hwangbo J.K, Keith A.M, Geniez J.M, Kraushaar D, Rowntree J, and Seel W. (2005). Interactions between the hemi-parasitic angiosperm Rhinanthus minor L. and its hosts: from the cell to the ecosystem. *Folia Geobotanica* 40(2-3), 217-229, 2005.

Cameron D.D. (2004). Role for differential host resistance to the hemiparasitic angiosperm, *Rhinanthus* minor (L) in determining the structure of host plant communities. Unpublished Ph. D Thesis, University of Aberdeen, UK.

Carnegies A.J, Bi, H.Q, Anorld, S, Li Y. and Binns D. (2009). Distribution host preference and impact of parasitic

mistletoes (Loranthaceae) in young eucalypt plantations in New South Wales. *Australia Botany* 87:49-63

Downey P.O. (1998). An in inventory of host species for each aerial mistletoe species (Loranthaceae and Viscaceae) in Australia. *Cunninghamia* 5:685-720

Gibson C.C and Watkinson A.R (199). The host range and selectivity of a parasitic plant: *Rhinanthus minor* L. *Oecologia* 78: 401-406

Ariwaodo J.O and Asobara J.L (2015). Preliminary Investigation on Flowering and Fruiting Pattern in a Plantation Grown *Afzelia africana* Sm Stand in Umuahia, Nigeria. *American Journal of Plant Science*, 6: 219 - 227. http://www.scirp.org/journal/aips http://dx.doi.org/10.4236/ajps.2015.61025

Kelly C.K. (1992). Resource choice in *Cuscuta europaea*. *Proceedings of National Academy of Science of the* USA 89:12194-12197

Kelly C.K and Horning K. (1999). Acquisition order and resources value in *Cuscuta attenuata*. Proceedings National Academic Science USA 96:13219-13222

Kuijt J. (1969). *The biology of parasitic plants*. University of California Press. Berkeley.

Lucy R. Shaanker R, and Jasoury G. (2011). The spatial distribution of mistletoe in a southern Indian tropical forest at multiple scale. *Biotropica* 43(1):50-57

Musseiman L.J and Press M.C. (1995). Introduction to parasitic plants. In: MC Press. JD Graves, eds. *Parasitic plants*, London, UK: Chapman and Hall, 1-3.

Nickren D.L and Musseiman L.J (2004). Introduction to Parasitic Flowering Plants. The plant health Instructor. Doi:10.1094/PHI-1-2004-0330-01

Nilson C.H and Svensson B.M. (1997). Host affiliation in two subarctic hemi-parasitic plants: *Bartsia alpine* and *Pedicularis laponica* . *Ecoscience* 4:80-85

Norton D.A and Carpenter M.A. (1998). Mistletoes as parasites: host specificity and speciation. *Trends in Ecology and Evolution* 13: 101-105

Okeke, A.I, Asiegbu, J.E, and Ariwaodo, J.O. (1995). The Effect of Spacing on the Growth and Yield of *Pinus caribea* Morlet and *Gmelina arborea* Rox in a Pine: *Gmelina* Mixed Plantation. *Nigeria Journal of Forestry*, 1-2, 75-82

Desale, O.Y, Griffiths M.E, and Ward D. (2016). Host specificity in parasitic plants-perspectives from mistletoes. *AoB PLANTS 8*: Plw069;doi:10.1093/aobpla/piw069

Osadebe P.O and Ukweze S.E. (2004). A comparative study of the phyto-chemical and antimicrobial properties of the Eastern Nigeria species of African mistletoe *(Loranthus micranthus*) sourced from different host area trees. *Journal of Biological Research and Biotechnology* 2(1):18-23

Pennings S.C and Callaway R.M. (2002). Parasitic plants: parallels and contrasts with herbivores. *Oecologia* 131:479-489.doi 10.1007/s00442-0923-7

Poulin R. and Randhawa H.S. (2015). Evolution of Parasitism along convergent lines from ecology to genomics. *Parasitology* 142(1):6-15

Press M.C. (1998). Autotrophy and heterotrophy in root hemi-parasites. *Trends Ecology Evolution* 4: 258-263

Press M.C and Graves J. (1995). Parasitic plants. London, UK: Chapman and Hall

Robert O.T, Frank G.H, and Donald, M.K (1982). Witches broom formation in conifers infected by *Arceuthobium spp*: an example of parasitic impact upon community dynamics. *American Midland Naturalist* 107: 351-359

Rubiales D. and Heide-J0rgensen, H.S (2011). Parasitic Plants. In: *Encyclopedia of Life Science*. John Wiley and Son Ltd: Chichester. DOI:10.1002/9780470015902.a0021271

Schulze E.D and Ehleringer J.R (1984). The effect of nitrogen supply on the growth and water use efficiency of xylem-tapping mistletoes. *Planta* 162:268-275

Seel W.E and Press M.C (1996). Effect of repeated parasitism by *Rhinanthus minor* on the growth and photosynthesis of a

perennial grass- *Poa alpina. New Phytologia* 134:495-502

Steven C.P. and Ragan M.C 2002. Parasitic plants: parallels and contrast with herbivores. *Oecologia* (2002) 131:479-489.DOI 10.1007/300442-002-0923-7

Thorgood C. J and Hiscock S.J (2010). Host specificity and speciation in parasitic plants. In: Rutgers DS (ed), *Phylogeography*: concepts, intra-specific pattern and speciation processes. New York, NY: Nova Science Publisher, Inc.

Turner, R.J and Smith, P. (2016). Mistletoes increasing in eucalypt forest near eden , New South Wales. *Australian Journal of Botany* 64:172-179.

Watson M.D. (2009). Determination of Parasitic Plant distribution: The role of host quality. *Botany* 87(1):16-21. Doi:10.1139/B08-105.

Westbury D.B. (2004). Biology Flora of the British Isles. *Rhinanthus minor* L. *Journal of Ecology* 92:906-927